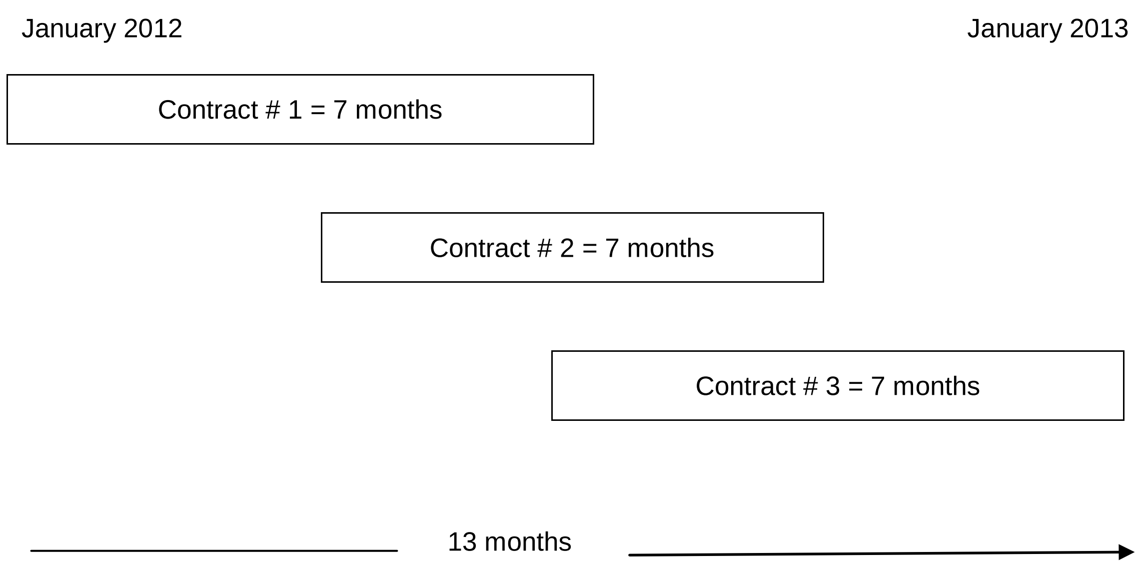
Appendix X
Air Quality and Climate Change Technical Appendix

The purpose of this technical appendix is to describe the modeling techniques used to estimate emissions associated with implementation of the proposed project.

Criteria Air Pollutants

Implementation of the proposed project would generate short-term emissions of ROG, NO_X, SO_X, CO, PM10, and PM2.5. These emissions from would result from heavy-duty equipment required to fell and clear trees, as well as vehicle travel to and from the project site. Emissions were estimated using the ARB's OFFROAD2007 model and the URBEMIS2007, Version 9.2.4 model. The project will require three separate tree removal contracts, each of which will include a maximum of four five-person crews, operating concurrently. All contracts will have a 90 "working day limit" and will expire after seven months (Stephenson pers. comm.). Figure 1 provides a graphical representation of how the time sequences for each contract will progress.

Figure 1. Contracting Schedule



During the tree removal period, a maximum of 20,000 trees will be removed and chipped. Three removal options are considered in this analysis. Option 1 assumes all 20,000 DDD trees would be removed in the greater Julian area. Option 2 assumes contracts 1 and 2 would operate in the Julian area, while the third contract would remove the remaining quota of trees in Descanso and Pine Valley areas. Option 3 assumes all 20,000 DDD tress would be removed in Descanso and Pine Valley areas.

Based on Figure 1, it was assumed that work on all three contracts would overlap at some point, and work on Contracts 1 and 2 and Contracts 2 and 3 would also occur concurrently for a period of time.

To ensure a conservative analysis, maximum daily emissions during these periods of overlap were estimated assuming all crew equipment would operate concurrently. Table 1 summarizes the heavy-duty equipment that will be operated by each crew.

Table 1. Tree Removal Equipment Assumptions

Equipment	Number Per Crew	Number per Contract[a]	Number During Contract 1/2/3 Overlap[b]	Number During Contract 1/2 & 2/3 Overlap[c]	Horsepower[d]	Hours per day
Chainsaw	2	8	24	16	5.7	3
Chainsaw	2	8	24	16	5.7	6
Tractor	1	4	12	8	82	4
Wood chipper	1	4	12	8	200	2
Truck	2	8	24	16	479	2
Blower	1	4	12	8	0.5	0.50

[a] Calculated by multiplying the number of equipment per crew by the number of crews per contract (4)
[b] Calculated by multiplying the number of equipment per crew by the number of crews per contract (4) and the number of contracts operating concurrently (3)
[c] Calculated by multiplying the number of equipment per crew by the number of crews per contract (4) and the number of contracts operating concurrently (2)
[d] Based on OFFROAD and URBEMIS default values

Once the trees are felled and chipped, they will be transported to a site for processing. It was assumed that one processing site would operate throughout all three tree removal contracts. Table 2 summarizes the equipment and operating assumptions for the processing site.

Table 2. Processing Site Equipment Assumptions[a]

Equipment	Number	Horsepower[b]	Hours per day
Tractor	1	120	5
Grinder	1	650	5

[a] The project will require off-road haul trucks to transport chipped wood to the stage area and to the off-site cogeneration facility. Operating assumptions associated with these vehicles are discussed below.
[b] Based on OFFROAD and URBEMIS default values.

The ARB's OFFROAD2007 model was used to estimate emissions from the equipment summarized in Tables 1 and 2. OFFROAD can be used to calculate emissions based on technology types, seasonal conditions, regulations, and activity assumptions. Emissions were generated for the equipment listed in Tables 1 and 2, which were assumed to operate in San Diego County during 2012.

The following equation was used to calculate emission factors for each criteria pollutant based on the OFFROAD emissions outputs.

*Emission factor = (tons/day) * (1/activity) * (1/horsepower)*

Where:

Tons/day = OFFROAD output for each criteria pollutant in tons per day

Activity = OFFROAD output for activity

Horsepower = Maximum horsepower calculated by OFFROAD

The resulting emission factors are summarized in Table 3. To calculate emissions for each piece of equipment, these factors were multiplied by the horsepower-hour (e.g. Grinder: 5 hours * 650 horsepower) and equipment load factor. Because crews will be working throughout the project area, all equipment was assumed to operate simultaneously to ensure emissions were not underrepresented.

Table 3. Equipment Emission Factors (tons per horsepower-hour)

Equipment	ROG	CO	NO_X	SO_2	PM	CO_2[a]	N_2O[a]	CH_4[a]
Chainsaw	4.52E-06	1.79E-05	1.26E-07	1.62E-09	1.03E-07	3.93E-05	4.32E-08	2.81E-07
Leaf Blower	1.84E-05	4.38E-05	3.70E-07	4.87E-09	6.89E-08	1.18E-04	1.99E-07	1.14E-06
Truck	2.26E-07	6.65E-07	1.95E-06	2.67E-09	7.05E-08	2.72E-04	0.00E+00	2.04E-08
Tractor	3.18E-07	1.48E-06	2.05E-06	2.53E-09	1.80E-07	2.15E-04	0.00E+00	2.87E-08
Chipper	3.77E-07	2.00E-06	3.36E-06	4.23E-09	1.71E-07	3.76E-04	0.00E+00	3.40E-08
Grinder	1.47E-07	5.69E-07	1.82E-06	2.42E-09	5.70E-08	2.47E-04	0.00E+00	1.33E-08

[a] Discussed below in GHG Emissions

Emissions from on-road workforce traffic were estimated using the URBEMIS2007 emissions model and the total number of personnel required to complete construction activities. It is estimated that each contract will require 20 personnel (four five-person crews). Assuming that each person will make two commute-based trips, approximately 40 gasoline-powered workforce trips will be made per day during per contract. Employee commute distances were based on URBEMIS default lengths.

Emissions from on-site employee movement were estimated based on information received from the project applicant. It was assumed that each crew would have two pick-up trucks, which would each make a maximum of five 10-mile trips around the construction site per day (40 daily trips per contract). Emissions associated with these vehicle trips were quantified using URBEMIS2007.

Hauling of the felled trees to staging areas was assumed to require five heavy-duty haul trips per day. (Burchill pers. comm. [B]) Each haul trip was estimated to be 5 miles (10 miles round trip). Once processed, the wood chips will be transported to the Colmac Energy Biomass-Fueled Power Plant (Colmac Plant) in Mecca, California. This facility is 90 miles from the Julian project site (180 miles round trip) and 180 miles from the Descanso and Pine Valley areas (360 miles round trip). It is estimated that a maximum of 540 heavy duty truck trips will be required to transport all chipped material (Stephenson pers. comm.). Emissions associated with these vehicle trips were quantified using URBEMIS2007. It was assumed that an average of 2 haul trips would be made per day (540 trips / 3 contracts / 90 days per contract).

Greenhouse Gas Emissions

GHG emissions from project activities are primarily the result of fuel use by equipment and vehicles. The primary GHG emissions generated by these sources are CO_2, CH_4, and N_2O.

GHG emissions from heavy-duty equipment were estimated using OFFROAD2007 and the assumptions described above (see Table 2). CO_2 emissions from vehicle travel were estimated using URBEMIS2007. URBEMIS does not quantify CH_4 and N_2O emissions from off-road equipment or worker commutes. Emissions of CH_4 and N_2O from diesel haul trucks were determined by scaling the CO_2 emissions predicted by URBEMIS by the ratio CH_4/CO_2 (0.000057) and N_2O/CO_2 (0.000026) emissions expected per gallon of diesel fuel according to California Climate Action Registry (2009). GHG emissions from on road pickup trucks and employee commutes were determined by dividing the annual CO_2 emissions by 0.95. This statistic is based on EPA's recommendation that CH_4, N_2O, and other GHG emissions account for 5% of on road emissions (U.S. Environmental Protection Agency 2009).

Removal of 20,000 trees is expected to produce 43,200 cubic yards of dry wood chips. It is assumed that 100% of the chipped wood will be sent to the Colmac Plant. (Stephenson pers. comm.) Based on an energy content of 4,700 kilowatt-hours (kWh) per ton of wood (National Renewable Energy Laboratory 2008) and a 28% efficiency factor for the Colmac Plant (Wiltsee 2000), the project will generate approximately 751,502 kWh of electricity.

Consistent with current purchasing agreements, electricity generated as a result of the project was assumed to be sold to Southern California Edison (SCE). It was assumed that the electricity generated by the proposed project from biogenic biomass would replace electricity and associated GHG emissions derived traditional sources. SCE's third party certified emission factor for CO_2 and state-wide factors CH_4 and N_2O (Table 4) were used to quantify GHG emissions that would have been emitted with the distribution of 751,502 kilowatt-hours of electricity.

Table 4. Electricity Emission Factors

Pollutant	Emission Factor
Carbon Dioxide	0.28617 kg CO_2/kWh[1]
Methane	0.000014 kg CH_4/kWh
Nitrous oxide	0.000004 kg N_2O/kWh

Sources: U.S. Environmental Protection Agency 2010; California Climate Action Registry 2010

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